

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (currently amended) A method of controlling a hybrid electric vehicle powertrain having a power unit, an energy storage ~~device~~ battery, and a controller responding to powertrain operating parameters including discharge power limit (DPL) and battery state of charge (SOC), the controller including a state machine having a plurality of states and an arbitrator for effecting a response to state machine change requests in accordance with the powertrain operating parameters, the method comprising a sequence of the following steps:

(a) monitoring the powertrain operating parameters;

([[a]]b) determining the values of the discharge power limit (DPL) and the state of charge (SOC) of the energy value of a parameter of said storage device battery;

([[b]]c) if ~~said~~ the state machine is in an OFF state, which requests that ~~said~~ the power unit be off, and ~~said parameter~~ the DPL is less than an ON level, causing ~~said~~ the state machine to transition from ~~said~~ the OFF state to an OPPORTUNISTIC state, which requests that ~~said~~ the power unit be kept on if already on;

([[c]]d) if ~~said~~ the state machine is in an ON state, which requests that ~~said~~ the power unit be on, and ~~said parameter~~ the DPL is greater than ~~said~~ the ON level, causing ~~said~~ the state machine to transition from ~~said~~ the ON state to ~~said~~ the OPPORTUNISTIC state;

([[d]]e) if ~~said~~ the state machine is in ~~said~~ the OPPORTUNISTIC state and ~~said parameter~~ the DPL is less than a MIN level, ~~said~~ the MIN level being less than ~~said~~ the ON level, causing ~~said~~ the state machine to transition from ~~said~~ the OPPORTUNISTIC state to ~~said~~ the ON state; and

([[e]]f) if ~~said~~ the state machine is in ~~said~~ the OPPORTUNISTIC state and ~~said parameter~~ the DPL is greater than an OFF level, ~~said~~ the OFF level being greater than ~~said~~ the ON level, causing ~~said~~ the state machine to transition from ~~said~~ the OPPORTUNISTIC state to ~~said~~ the OFF state.

2. (canceled.)

3. (canceled.)

4. (currently amended) ~~The method of Claim 3 wherein said parameter is the state of charge (SOC) of said battery.~~ A method of controlling a hybrid electric vehicle powertrain having a power unit, an energy storage battery, and a controller responding to powertrain operating parameters including discharge power limit (DPL) and battery state of charge (SOC), the controller including a state machine having a plurality of states and an arbitrator for effecting a response to state machine change requests in accordance with the powertrain operating parameters, the method comprising a sequence of the following steps:

(a) monitoring the powertrain operating parameters;

(b) determining the values of the discharge power limit (DPL) and the state of charge (SOC) of the energy storage battery;

(c) if the state machine is in an OFF state, which requests that the power unit be off, and the SOC is less than an ON level, causing the state machine to transition from the OFF state to an OPPORTUNISTIC state, which requests that the power unit be kept on if already on;

(d) if the state machine is in an ON state, which requests that said power unit be on, and the SOC is greater than the ON level, causing the state machine to transition from the ON state to the OPPORTUNISTIC state;

(e) if the state machine is in the OPPORTUNISTIC state and the SOC is less than a MIN level, the MIN level being less than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the ON state; and

(f) if the state machine is in the OPPORTUNISTIC state and the SOC is greater than an OFF level, the OFF level being greater than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the OFF state.

5. (currently amended) ~~The method of Claim 3 wherein said parameter is the discharge power limit (DPL) of said battery calculated on a real time basis.~~ A method of

controlling a hybrid electric vehicle powertrain having a power unit, an energy storage battery, and a controller responding to powertrain operating parameters including discharge power limit (DPL) and battery state of charge (SOC), the controller including a state machine having a plurality of states and an arbitrator for effecting a response to state machine change requests in accordance with the powertrain operating parameters, the method comprising a sequence of the following steps:

- (a) monitoring the powertrain operating parameters;
- (b) determining the values of the discharge power limit (DPL) and the state of charge (SOC) of the energy storage battery;
- (c) if the state machine is in an OFF state, which requests that the power unit be off, and the DPL or SOC is less than an ON level, causing the state machine to transition from the OFF state to an OPPORTUNISTIC state, which requests that the power unit be kept on if already on;
- (d) if the state machine is in an ON state, which requests that said power unit be on, and the DPL or SOC is greater than the ON level, causing the state machine to transition from the ON state to the OPPORTUNISTIC state;
- (e) if the state machine is in the OPPORTUNISTIC state and the DPL or SOC is less than a MIN level, the MIN level being less than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the ON state; and
- (f) if the state machine is in the OPPORTUNISTIC state and the DPL or SOC is greater than an OFF level, the OFF level being greater than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the OFF state.

6. (currently amended) The method of Claim [[3]] 1 wherein ~~said levels~~ are the step of monitoring the powertrain operating variables includes monitoring the drive mode of the powertrain to determine whether it is in reverse drive or forward drive, the ON level and the OFF level being dependent on the drive mode of a vehicle transmission.

7. (currently amended) A method of controlling a hybrid electric vehicle having a power unit, an energy storage ~~device~~ battery, a transmission, and a controller

including a state machine having a plurality of states including an ON state, which requests that said power unit be on, an OFF state, which requests that said power unit be off, and an OPPORTUNISTIC state, which requests that said power unit be kept on if already on, the method comprising a sequence of the following steps:

(a) determining the ~~value~~ values of a ~~parameter~~ discharge power limit (DPL) and a state of charge (SOC) of ~~said the energy storage device battery~~;

(b) if ~~said the state machine~~ is in ~~said the~~ ON state and ~~said parameter the DPL or SOC~~ is greater than an ON level, causing said machine to transition from ~~said the~~ ON state to ~~said the~~ OPPORTUNISTIC state;

(c) if ~~said the state machine~~ is in said OFF state and ~~said parameter is the DPL or SOC~~ is less than an ON level, causing ~~said the state machine~~ to transition from ~~said the~~ OFF state to ~~said the~~ OPPORTUNISTIC state;

(d) if ~~said the state machine~~ is in ~~said the~~ OPPORTUNISTIC state and ~~said parameter the DPL or SOC~~ is less than a MIN level, wherein ~~said the~~ MIN level is less than ~~said the~~ ON level, causing ~~said the state machine~~ to transition from ~~said the~~ OPPORTUNISTIC state to ~~said the~~ ON state; and

(e) if said machine is in ~~said the~~ OPPORTUNISTIC state and ~~said parameter the DPL or SOC~~ is greater than an OFF level, wherein ~~said the~~ OFF level is greater than ~~said the~~ ON level, causing ~~said the state machine~~ to transition from ~~said the~~ OPPORTUNISTIC state to ~~said the~~ OFF state.

8. (withdrawn) A controller for a hybrid electric vehicle having a power unit and an energy storage device, said controller comprising:

a state machine having a plurality of states including an ON state, which requests that said power unit be on, an OFF state, which requests that said power unit be off, and an OPPORTUNISTIC state, which requests that said power unit be kept on if already on;

means for determining the value of a parameter of said storage device;
means for requesting a transition of said machine from said OFF state to said OPPORTUNISTIC state if said parameter drops below an ON level;

means for requesting a transition of said machine from said ON state to said OPPORTUNISTIC state if said parameter rises above said ON level;

means for requesting a transition of said machine from said OPPORTUNISTIC state to said ON state if said parameter drops below a MIN level, which is less than said ON level; and

means for requesting a transition of said machine from said OPPORTUNISTIC state to said OFF state if said parameter rises above an OFF level, which is greater than said ON level.

9. (withdrawn) The controller of Claim 8 wherein said vehicle includes a transmission and the MIN level, ON level, and OFF level are one set of values when the transmission is in a drive position and another and respectively higher set of values when the transmission is in a reverse position.

10. (currently amended) A method of controlling the starting and stopping of a power unit of in a hybrid electric vehicle having an energy storage ~~device~~ battery, and a controller including an arbitrator for commanding the power unit to start or stop based on an evaluation of ~~arbitrator~~ requests to the arbitrator, the method comprising a sequence of the following steps:

(a) determining the value of a ~~parameter~~ discharge power limited (DPL) and a state of charge (SOC) of said the energy storage device battery;

(b) if the power unit is off and the level of ~~said parameter~~ the DPL or SOC is greater than an ON level, issuing an arbitrator request to turn the power unit off;

(c) if the power unit is off and the level of ~~said parameter~~ the DPL or SOC drops below ~~said the~~ ON level, issuing an arbitrator request that the engine be kept on if the power unit is presently on; and

(d) if the level of ~~said parameter~~ the DPL or SOC is less than a MIN level, issuing an arbitrator request that the power unit be turned on until the level of ~~said parameter~~ the DPL or SOC achieves ~~said the~~ ON level, and thereafter issuing a request that the power unit be kept on if the ~~engine power unit~~ is presently on.

11. (withdrawn) The controller defined in Claim 9 wherein said ON level has a value that is between said MIN level and said OFF level.

12. (currently amended) The method of Claim 10 wherein ~~said the~~ vehicle includes a transmission and ~~said the~~ controller stores first and second sets of MIN, ON, and OFF levels, the first set being for use when the transmission is in a forward drive ~~position~~ mode and the second set for use when the transmission is in a reverse ~~position~~ drive mode.

13. (currently amended) The method of Claim 12 wherein the values of ~~said the~~ second set are higher than the respective values of ~~said the~~ first set.

14. (canceled.)

15. (canceled.)

16. (currently amended) A method of controlling a hybrid electric vehicle having a power unit, an energy storage ~~device~~ battery and a controller including a state machine having a plurality of states, the method comprising a sequence of the following steps:

(a) determining the value of a ~~parameter~~ discharge power limit DPL and a state of charge (SOC) of the storage ~~device~~ battery;

(b) if the state machine is in an ON state, which requests that ~~said the~~ power unit be on, and the ~~parameter~~ DPL or SOC is greater than an ON level, causing the state machine to transition from the ON state to an OPPORTUNISTIC state; and

(c) if the state machine is in the OPPORTUNISTIC state and the ~~parameter~~ DPL or SOC is less than a MIN level, the MIN level being less than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the ON state.

17. (currently amended) A method of controlling a hybrid electric vehicle having a power unit, an energy storage ~~device~~ battery, and a controller including a state machine having a plurality of states, the method comprising a sequence of the following steps:

(a) determining the value of a parameter discharge power limit (DPL) and a state of charge (SOC) of the storage ~~device~~ battery;

(b) if the state machine is in an OFF state, which requests that the power unit be off, and the parameter is less than an ON level, causing the state machine to transition from the OFF state to an OPPORTUNISTIC state, which requests that the power unit be kept on if already on; and

(c) if the state machine is in the OPPORTUNISTIC state and the parameter DPL or SOC is greater than an OFF level, the OFF level being greater than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the OFF state.

18. (withdrawn) A controller for a hybrid electric vehicle having a power unit and an energy storage device, the controller comprising:

a state machine having a plurality of states including an ON state, which requests that the power unit be on, an OFF state, which requests that the power unit be off, and an OPPORTUNISTIC state, which requests that the power unit be kept on if already on;

means for determining the value of a parameter of the storage device;

means for requesting a transition of the machine from the OFF state to the OPPORTUNISTIC state if the parameter drops below an ON level; and

means for requesting a transition of the machine from the ON state to the OPPORTUNISTIC state if the parameter rises above the ON level.

19. (withdrawn) A controller for a hybrid electric vehicle having a power unit and an energy storage device, the controller comprising:

a state machine having a plurality of states including an ON state, which requests that the power unit be ON, an OFF state, which requests that the power unit be OFF, and an OPPORTUNISTIC state, which requests that the power unit be kept on if already on;

means for determining the value of a parameter of the storage device;

means for requesting a transition of the machine from the OPPORTUNISTIC state to the ON state if the parameter drops below a MIN level, which is less than the ON level; and

means for requesting a transition of the machine from the OPPORTUNISTIC state to the OFF state if the parameter rises above an OFF level, which is greater than the ON level.